A Work Project, presented as Part of the Requirements for the Award of a Master's Degree in Management from the University NOVA – School of Business and Economics.

Optimization of Export Support Systems

How to Promote Exports from Portugal to Germany in the Area of Information Technology and Electronics

Jürgen Thomas Weber - 1769

A Project carried out under the Supervision of:

Professor Alexandre Dias da Cunha

7th of January 2015

Abstract

The present paper is a personal reflection on a work project carried out to promote exports from Portugal to Germany in the IT area, under consideration of the deliverables required by the clients CCILA and Anetie. The project outcome approaches the fact that the majority of the Portuguese market players has disadvantages in size and does rarely coordinate activities among each other, which hinders them to export successfully on a broad scale. To bring together Portuguese delivery potential and German market demand, expert interviews were conducted. Based on the findings, a concept was developed to overcome the domestic collaboration issues in order to strengthen the national exports in the identified sector - embedded systems implementation services for machinery and equipment companies.

Keywords: Export promotion, Domestic collaboration, IT, SMEs

Table of Contents

List of Abbreviations

Abbreviation	Meaning
Anetie	Associação nacional das empresas das tecnologias de Informação e electrónica
BI	Business Idea
Big Four	The four largest international professional services networks
B2B	Business-to-Business
CCILA	Câmara de Comércio e Indústria Luso-Alemã
CPS	Cyber-Physical Systems
ESI	Embedded Systems Implementation
Fraunhofer IPA	Fraunhofer Institute for Manufacturing, Engineering and Automation
GE®	General Electric
IT	Information Technology
IoT	Internet of Things
I-4.0	Industry 4.0/Industrie 4.0
M&E	Machinery and Equipment
RBSC	Roland Berger Strategy Consultants
SMEs	Small and Medium-Sized Enterprises

Introductory Note:

Since the present thesis summarizes a relatively exhaustive work project, it frequently refers to attachments which contain extracts from the actual PowerPoint presentation. Please be aware that these references are an essential part of the work and are therefore necessary to be consulted. The annexes can be found in the attached document “Appendices”.

1. Overview of the Project

a. Clients – CCILA and Anetie and their Common Initial Situation

Within the scope of cooperation, the university Nova School of Business and Economics and the Câmara de Comércio e Indústria Luso-Alemã (CCILA) in Lisbon have recently begun to give master students the possibility to write their final paper with practical relevance. The studies deal with topics, which reflect the interest of the CCILA to promote economic and trade relations between Portugal and Germany. For the present paper, the CCILA predetermined the object of investigation to the promotion of exports from Portugal to Germany in the area of information technology (IT) and electronics concerning Portuguese small and medium-sized enterprises.

For this purpose, the Portuguese business association Anetie was invited to participate in the project. The intention behind the involvement of a business association of the IT area has practical reasons: The project team gets the opportunity to directly address the needs of a private organization, which itself has the ability to put the final recommendations into practice.

A preliminary study of Roland Berger Strategy Consultants (RBSC) and the CCILA analyzed the bilateral trade relations between Portugal and Germany. The work revealed an awareness problem of German companies about the Portuguese economy. According to the study, 92% of these companies associate Portuguese firms with traditional sectors[1] and just 8% relate them with expertise in technological products (RBSC 2013, p. 21). Even though this is a subjective perception and does not reflect the reality (see Appendices: Figure 1), it shows the difficulties the Portuguese economy is facing while aiming to position itself as an exporter of technological products and services. According to Mr. João Brazão, an Anetie director and their representative in this project, Portuguese companies lack cooperation and coordination and do rather compete intensively among each other than collaborating to strengthen the national export sector.

[1] Examples of the traditional sectors mentioned in the RBSC study: Tourism, wine and cork

Despite these findings, the RBSC investigation has also shown that Portugal has recently started to attract multinational companies, which establish technology centers and benefit from Portuguese location factors like modern infrastructure and qualified and flexible employees at comparatively low wages (RBSC 2013, p. 12-13)[2]. This example of *Foreign Direct Investments* shows that the Portuguese economy has internationally competitive strengths in the area of knowledge-intensive services. The challenge of this study was therefore to apply the Portuguese economic potential to strengthen the national exports of IT products or services to Germany.

b. The Project Challenge

The challenges of this report can be subdivided into three main areas. Firstly, all processes had to be thoroughly planned in advance, the findings had to be assessed and finally specific proposals and recommendations had to be made. This extensive procedure represents the organizational challenge and had to be done under consideration of the second project challenge – the time limit of one semester. Throughout the project, the deliverables required by the CCILA had to be fulfilled and our clients had to be briefed on regular basis. In the course of this, it was necessary to appraise and implement consistently the clients' feedback and requirements in order to meet their individual expectations. Thirdly, we needed to solve the issue-specific challenge of finding potential demand in the German market and "match" it with Portuguese capabilities and competencies (see Appendices: Figure 2). This involved an in-depth study of the German- and the Portuguese market, which was mostly performed by conducting expert interviews. This matching process posed us with a particular challenge, since the traditional German IT market is considered as mature and highly competitive (EMC Corporation 2014). The following section will deal with the task to identify market demand in Germany which can be met with Portuguese' resources and competencies.

[2] The project´s team investigations could confirm, that multinational companies currently expand their IT intensive activities in Portugal (Interviewee: IT manager in a German Blue-Chip company in Portugal)

c. Market Overview and Subsector Identification

The comparison of both countries' trade data reveals a large imbalance. While Germany ranks as the 2nd most important exporter and importer for Portuguese goods and services and accounts for 11% of the trade volumes respectively, Portugal just accounts for around 0,5% of the German external trade (see Appendices: Figure 1). Furthermore, Germany's traditional IT market is highly penetrated by multinational companies and strong domestic firms. Since these findings were already clear at an early stage of the project, it was out of question that the members of Anetie[3] had to follow a narrow niche strategy in an area which allows them to utilize their strengths. Consequently, and for the purpose of establishing a competitive advantage, we had to find a suitable niche[4] and the necessary key success factors which are crucial to compete in the identified market successfully (see "d. Summary of Recommendations - Recommended Target Market")

Our solution to solve the described challenges was to take up a "game changing" macro trend[5] (see Appendices: Figure 3), which is called *Internet of Things* (*IoT)*. Since the highest economic potential within this trend is expected to arise in the manufacturing industry (Experton Group 2014, p. 32), we decided to focus on the subtopic *Industry 4.0 (I-4.0)*.[6] *I-4.0*, as the industrial part of the *IoT*, is about the connection of intelligent machines, production systems and processes to a sophisticated network (Acatech 2013, p. 13-16) and can be broken down into five technology fields (see Appendices: Figure 4). While the technical part might sound at the first sight abstract (see Appendices: Figure 5), it promises substantial efficiency gains, value creation and a huge growth potential for the following decades. For instance, the estimated value creation in Germany due to *I-4.0* amounts approx. 78.77 billion EUR until 2025, the German industry invests about 40 billion EUR a year for *I-4.0* products and services until 2020 and the production and resource utilization is expected

[3] Representative for Portuguese SMEs in the IT area

[4] The selection criteria of the niche are based on suggestions of the preliminary RBSC study (May 2013, p. 40): German market dimension, Missing resources in Germany, Potential in Portugal, Available resources in Portugal

[5] By performing a STEEP analysis

[6] Also called: Smart Internet, Industrial Internet, Internet of Things in Manufacturing, Smart Production and Advanced Manufacturing

to increase by 18 % within five years (see Appendices: Figure 6). It is expected that the so called *4rd Industrial Revolution* (Acatech 2013, p. 13) towards *I-4.0* will pick up speed and gain relevance in the upcoming two to three years (Experton 2013, p. 32) and will be fully completed within the next 15 years (Experton 2013, p. 14). In addition to that, the German government supports investments in *I-4.0* with a national strategy and development funds of 200 million EUR (Tönnesmann 2014), which demonstrates the long-term importance of *I-4.0* for the German market. A growing demand in the near future for *I-4.0* products and services can therefore be assumed. It is expected that *I-4.0* creates many new business models, which especially provide opportunities for SMEs and start-ups in the B2B area (Acatech 2013, p. 5 and p. 16)

The fact that even Michael Porter, the father of the *Five Forces that Shape Competition*, adapted his theory to the potential of the *IoT in Manufacturing* to reshape industry structures and boundaries, shows the extent of the prospective changes.[7] Our investigations revealed furthermore, that Siemens® already changed its organizational structure to be prepared for *I-4.0* (Interviewee: IT manager in a German Blue-Chip company in Portugal) and GE® as well (Iansiti and Lakhani 2014). It is for these reasons, that this moment in time seems to be the right window of opportunity for Portuguese SMEs to anticipate to the upcoming changes and opportunities induced by *I-4.0*. Based on the findings mentioned above, it can be derived that new market opportunities arise which give Portugal realistic chances to enter the German market and after all increase significantly its exports in the area of IT.

Subsector Identification

The interviews with German experts enabled us to identify four subsectors (see Appendices: Figure 7), which show promising market potential in Germany within the area of *I-4.0*. These are in particular: IT Security, Embedded Systems Implementation (ESI), *Big Data* and *Cloud* Infrastructure (see Appendices: Figure 8). Even though certain Portuguese SMEs might be able to serve specific needs within each of the sectors, our ambition was to meet the requirements of the CCILA. According to their objectives, the work should aim to increase the exports of goods or services "considerably", "long lasting" and finally unfold the "full

[7] See for more details "3. Reflection on Learning - b. New Knowledge"

potential of exports that Portugal may have" (CCILA, 2014). For this purpose, we developed a market attractiveness ranking (see Appendices: Figure 9), which considers Porter's *Five Forces* and other market attractiveness factors in order to assess the information obtained in interviews and additional research. Although it turned out that IT Security would theoretically be the most attractive segment, we chose ESI as the subsector for our business idea. ESI meets our goal to derive a mutually benefiting "match" between Portuguese competencies and marketability on one hand and promising market attractiveness in Germany on the other hand (see Appendices: Figure 10). In my opinion, we chose the ideal trade-off which could allow Portuguese SMEs to benefit in the long-run from sector specific capabilities and competencies, their own know-how and furthermore the favorable location factors in Portugal, which we identified in the second phase of the study.

Following our project-specific definition[8], ESI has the task to integrate embedded systems into production processes and lines, industrial facilities and products manufactured by component suppliers. According to an interviewee (Deputy head of a German research institute), the large part of the value creation of ESI accounts for software tasks. Thus, we consider the export activities in the following as the export of services.[9] In addition, this interviewee pointed out that there is a huge potential for embedded system integrators upcoming[10] in Germany. Driven especially by automobile manufacturers, in the near future suppliers of industrial products will be forced to provide products, which are ready to be integrated into Cyber-Physical Systems (CPS)[11] in factories[12] (Interviewee: Project manager I-4.0 in a major business association in Germany). Subsequently, the suppliers of such goods need to integrate embedded systems into their products, which will be either processed or integrated into production lines. Especially smaller companies do not have the know-how and resources needed to fulfill that task by their own (Interviewee: German business

[8] Derived from the information obtained from interviews and research

[9] It follows, that embedded software companies are the exporters. Due to financial reasons, it is very probable that embedded hardware would be ordered from abroad (e.g. China)

[10] This opinion was confirmed by three more interviewees

[11] Explanation CPS: "enable the physical world to merge with the virtual leading to an Internet of things, data and services. One example of CPS is an intelligent manufacturing line, where the machine can perform many work processes by communicating with the components" (taken from http://www.eitictlabs.eu)

[12] A very simplified illustration can be seen in Appendices: Figure 11

development executive in an US American IT company I; also: Experton Group 2014, p. 10), which opens a great market opportunity for implementation services. Portugal´s high-qualified, flexible and relatively cheap labor force give the country a comparative advantage with respect to its location factors in contrast with Germany. Furthermore, these employees have very good English skills and use their innovative mindsets to overcome *I-4.0* related problems with more success than their German colleagues (Interviewee: IT manager in a German Blue-Chip company in Portugal). These positive findings, together with the fact that Anetie has several qualified member companies operating in the area of embedded systems software, make them suited to export ESI services.

d. Summary of Recommendations

Before presenting the recommendations, I would like to call to mind the situation, that Portuguese SMEs are currently facing in view of the IoT and in particular of the export of ESI services (see Appendices: Figure 12). This additional explanation helps to understand our attempt to find a "balanced" match between the Portuguese capabilities and the German market demand.

Unlike in Germany, the Portuguese government has not yet established a national strategy towards the IoT in Manufacturing. As a result, Portuguese firms do not have the possibility to orientate and pool their activities towards nationwide goals, nor to align and pool their competencies to achieve sector-wide objectives. This is compounded by the fact that the Portuguese (ESI) industry consists mostly of small market players which lack, viewed on their own, the resources to expand their businesses to foreign markets. However, a coordinated collaboration among the national players would enable them to overcome the problems caused by the lack of scale, the awareness-problems abroad13 and the unawareness of potential business opportunities in Germany. In contrast, the Portuguese employees´ outstanding I-4.0 problem-solving competences, their high qualification and flexibility, their good English skills and, in comparison to their German counterparts, relatively low wages are strong arguments in Portugal´s favor to position itself as a prospective exporter of ESI services.

[13] The interviews showed, that the German market is mostly not aware about the Portuguese delivery potential

Recommended Target Market

Having regard to the assets and drawbacks of the national competencies in the area of ESI, we recommend to consider the framework we developed to narrow down the targeted niche as much as possible. As Appendix Figure 13 shows, the framework is based on four selection criteria. The composition of the criteria was elected in order to bring together the Portuguese ESI exporters and a suitable target market and consider therefore the market potential and customer needs in Germany, as well as the Portuguese capabilities.

For instance, the smaller the targeted enterprises are, the less know-how and resources they will usually have to equip their products with embedded systems (Interviewee: German business development executive in an US American IT company I). Another crucial variable is the customization of their products. While automotive parts are mostly standardized, they just require an initial implementation concept which might be slightly changed over time. In contrast, Machinery and Equipment (M&E) companies produce in many cases single pieces or in small series, which does require a high degree of customization and therefore ongoing demand for ESI services. Applying this framework on three potential target markets results in our recommendation to target M&E companies with maximum 500 employees (see Appendices: Figure 14)

Key Success Factors for the Recommended Target Market

Since the identification of a (sustainable) competitive advantage is crucial to compete successfully in a market, we conducted interviews[14] to identify the customer needs and preferences to obtain the key success factors for the market of M&E companies (see Appendices: Figure 15). The recommended target market along with the associated key success factors represent the basis for the development of the business idea, which follows hereafter.

[14] Interviewees: Partner and head of industrial production of one of the *Big Four*, operations manager industrial products in one of the *Big Four*, head of strategic management and marketing of an industrial software company and two research assistants in a product engineering research group

Proposal of a Business Idea - Embedded Systems Implementation Platform

The following description of a business idea, which we call the "Embedded Systems Implementation Platform", aims to overcome the problems stated above: The domestic firms usually do not collaborate with each other, the ESI industry consists of small market players, there is no national strategy to follow and the firms therefore do not coordinate their activities to achieve common goals. What seems like the situation of an ordinary competitive market, hinders the Portuguese (ESI) industry not only from taking market opportunities, but also from increasing its exports.

Our concept´s purpose is to bring several Portuguese interest groups together in order to pursue a commonly shared primary objective – entering the German market to sell ESI services. The approach we propose consists basically of two steps. Firstly, we recommend that the market participants follow the tasks needed to strengthen the "Coordination within Portugal". Secondly, the pooled skills should allow them to "Reach the Customer in Germany". Since each of the "steps" requires several, mostly consecutive tasks I would like to briefly introduce to the methodology we used.

Appendix, figure 16 displays the "platform structure", which is a very simplified illustration of the recommended approach. The left hand side of the illustration shows "Step 1: Coordination within Portugal", while the right hand side shows "Step 2: Reaching the customer in Germany". In the presentation for our clients, both steps are further broken down into "phases". To give a better overview, both steps provide a summary table (see Appendices: Figure 17 and 18), showing "phases" on the left column and the "estimated time" for each phase on the right column. Aside from that, please note that, "phases" might be further divided into "sub-items". In that case, a small orange box (e.g. E. 3.a) contains the designation of a slide, which provides further information. Since the platform proposal is quite comprehensive, the following explanations will be limited to the main ideas behind the different elements.

Step 1: Coordination within Portugal[15]

Even though initially the interests of the different groups in Portugal seem to differ, they all benefit from increasing exports. For instance, universities and research centers[16] can apply their techniques to real projects and gain practical experience; domestic M&E companies benefit from technical innovations; ESI companies get access to research know-how, share tasks with other ESIs and can therefore focus on their own core competencies, etc. In order to achieve the goal to coordinate the national competencies and know-how, we propose in "Phase 1" sub-items such as: "Platform Composition", "Common Strategy" and "Organizational Structure". While the sub-category "Platform composition" shows merely an exemplary composition of platform members and assigns roles and tasks, the sub-category "Common Strategy" serves as the foundation of the platform (see Appendices: Figure 19). It takes over the task of the missing national strategy, which means that it sets the "Vision", "Mission Statement", "Statement of Values" and "Strategy Statement" (Grant 2010, p. 23). The idea is that all platform members agree on shared "rules" and, above all, collaborate in order to pool their competencies and complement each other´s expertise. The initial disadvantages of missing a national strategy to face the upcoming challenges of the *IoT* and having relatively small ESI companies with limited resources can therefore be turned into an advantage for the platform members since they can significantly increase their possibilities. To ensure the adherence with the assigned tasks, we designed an "Organizational Structure" (see Appendices: Figure 20), which shows in a clear and comprehensible manner the formally involvement of all parties.

The sub-item „Organizational Activities and Other" of phase 2 contains suggestions regarding formal activities and displays opportunities resulting by the gain in market power. For example, we recommend to choose a legal form, which enables the platform to apply for public funds[17]. We furthermore address the branding issue (we propose the use of a common logo to create a uniform corporate identity) and recommend to make use of greater

[15] A practical example of successful national cooperation: It´s OWL (www.its-owl.com) is a regional alliance of businesses and organizations. It aims to pool the members resources to compete internationally

[16] For example Cister - Research Centre in Real-Time and Embedded Computing Systems

[17] For example, Horizon 2020 – of the European Commission

purchasing power for embedded hardware, etc. In my opinion, the need to start the "Development of a Proof of Concept" as soon as possible is an even more important aspect. Regarding interviewees (Head of strategic management and marketing of an industrial software company; Two research assistants in a product engineering research group), it is crucial to show an advanced concept of the products/services[18] before getting in contact with German market players (see "step 2" for further explanation). This task involves especially universities and research institutes as well as domestic M&E companies. This is due to the fact, that the proof of concept has to be developed based on technological requirements, the key success factors we identified and needs finally to be tested under real-life conditions. Phase 3 can be delayed until our solutions are ready for the market, since it deals with the need of a "Local Company Representative" to sell the ESI solutions to customers and provide services.

Step 2: Entering the German Market

While step 1 mainly deals with organizational issues, Step 2: "Entering the German Market" has the objectives to drive research and product development forward and finally distribute the market-ready solutions. Based on various expert interviews[19], we developed a customized concept, which is supposed to lead to the goal of entering successfully the German market. The importance of such a concept came to our mind when an interviewee (Deputy head of a German research institute) addressed the issue "how to stand apart from the (Chinese) competition?". The concept therefore combines the opinions and ideas of several experts to a step-by-step approach. It goes without saying that the concept should be understood as a guideline, which has to be adapted, if necessary.

Appendix, figure 21 gives an overview of the processes which should be followed in phase 1. According to several interviewees (Project assistant Cyber-Physical-Systems in a German SME; German Business Development Executive in an US American IT company II, etc.), "Building Personal Relationships" with associations and research institutions is the outset to enter the market. The "Proof of Concept" of step 1 opens the door to initial talks and

[18] As mentioned before, we say ESI "services", due to simplification reasons
[19] Interviewees will be quoted in context of the information application

consecutively delegation visits which should be combined with visiting trade fairs and conferences in Germany. The objective to "Build Reputation" is best achieved by getting into "R&D Projects"[20] with a local partner[21]. Since innovative solutions are sold to a great extent at trade fairs, interviewees (Deputy head of a German research institute, Partner and head of industrial production of one of the Big Four, etc.) pointed out that the improved reputation by R&D projects is decisive to stand out from the mass of sellers at trade fairs. The cooperation enables the platform furthermore to publish specialist articles in technical journals and business-publications and gives use cases more credibility and increases their reach and efficiency. This procedure should finally lead to phase 2 and "The Reference Project" - the first order of a German M&E company. The purchase order serves after completion as the reference project and the key to the German market. It is the bottleneck of the approach to enter the market, where the success of the business idea stands and falls (see Appendices: Figure 22).

Phase 3 and the "Product Introduction and Distribution" is the last sub-item of our platform proposal. It deals with the changed focus from cooperation partners to the buyer of the ESI services - M&E companies - and adds therefore the missing elements of the marketing mix price, promotion and distribution.

To allow the evaluation of success of the platform, Appendix - Figure 23 contains a timeframe including the goals and objectives, which should be achieved. Besides qualitative measures, we chose the quantitative measure "Being among the top 10 ESI providers in the German market[22]" within 55 months after starting the platform project.

e. Reflection on the Work Done

I would like to emphasize that the BI presented above represents just one among many other possibilities within the identified subsectors, which might have the potential to succeed in the German market. Even if I think the export of ESI services is from the current perspective the most promising area in consideration of the objectives required by the CCILA, our

[20] Besides the need of R&D to build reputation, such projects are necessary to develop customized solutions
[21] Research institutions or companies
[22] Measurement by market share

frameworks are applicable to other business opportunities which could already be put into practice or might arise in the future. Even though I chose to present in the following section a BI which serves as a "value adding element" of the platform presented above, there are also BIs which require other hurdles to overcome on the Portuguese side than coordination and collaboration issues. To show the contrast to those who are interested, I prepared a brief explanation of a business opportunity, which could be put into practice by only a single company (see Appendices: Figure 24)

2. Further Development of a Specific Topic

As the previous part of the study shows, embedded systems are the basis for cyber-physical systems, which themselves constitute the data infrastructure of the *IoT* (BMW 2014, p. 7). Applying CPS in the manufacturing environment generates a large quantity of data, which (prospectively) can be used to provide *Big Data* solutions for manufacturing enterprises (Bauer and Schlund 2014, p. 19). This is the starting point behind the idea of adding an additional "element" to the ESI platform concept. The following proposal was inspired by several examples from real life, which demonstrate the proof of functionality of the concepts behind the proposed ideas.

Explanation of the Concept

To illustrate the idea to connect the ESI platform with data based software services, I would like to use an analogy with Google®. As is generally known, Google® started as a search engine to give users the possibility to explore the internet. People´s initial intention to use Google® was simply to find information, which however laid the foundations for a vast number of products and services constructed around the information the search engine provides.[23] Although on a much smaller scale, a similar approach could be applied to the ESI platform. Embedded systems, once they connect machines with each other to a CPS, generate real-time machine data (see Appendices: Figure 11). These machine-data can be seen as the search queries Google® gets from its users. Instead of using search queries to customize

[23] In my opinion, Google® is currently using the same approach to "revolutionize" the energy sector as they did years ago with their search engine and the internet. Instead of using a search engine to get access to data, Google® took over the digital thermostat and smoke detector company "Nest®", which will provide Google® access to real-time data on energy consumption (see also Iansiti and Lakhani 2014, p. 95)

internet advertisement, M&E companies can use machine-data to provide value adding services for their customers (Bauer and Schlund 2014, p. 21). Hence, the targeted M&E companies provide their customers with the infrastructure to generate and access data, but lack the know-how (see Appendices: Figure 14) to make use of it. This opens the door to expand the platform´s range of services with *Big Data* solutions and enables it as a result, to cover a bigger share of the value chain.[24]

Market Opportunities

The range of possibilities of *Big Data* is expected to become enormous and to offer many business opportunities for established software companies as well as for start-ups (BMWi 2014, p. 10). Possible fields of services range from "sensor-driven decision analytics" and "process optimization" to "optimized resource consumption" (Chui and Löffler and Roberts 2010, para. 5, 7, 8). This goes along with the fact that the introduction of the *IoT in Manufacturing* causes a fundamental change of the existing value chains. Physical products and digital services will be combined to new innovative offerings (BMWi 2014, p. 7) and "expertise in software development becomes increasingly important" (Iansiti and Lakhani 2014, p. 99). From these findings it can be concluded that the customer needs are subject to significant changes (Iansiti and Lakhani 2014) in the near to medium term and leads to strong demand for "single-source solutions" in case of data infrastructure. This argument can be supported by interviewees (Partner and head of industrial production of one of the Big Four, Operations manager industrial products in one of the Big Four) who confirmed that competencies like "vertical and horizontal networking" and "goal-oriented problem-solving skills" are expected by manufacturing enterprises from their component and machinery suppliers. Expressed in figures, revenues of *Big Data* solutions will increase from 6.1 billion EUR in 2014 to 13.6 billion EUR in 2016 in Germany (Bitkom 2014). GE®, as one of the first companies worldwide, which has already started to "digitize" its business models, could generate additional revenues of 1.5 billion EUR in 2013 and expects it to double in 2014 and again in 2015 by tiding product sales with *Big Data* services to improve the machinery

[24] The idea of creating a "platform" for software SMEs which offer I-4.0 Big Data solutions is not new. The Fraunhofer IPA operates a pilot project called *Virtual Fort Knox*, which gives SMEs in the software area the chance to offer their solutions to manufacturing enterprises (Interviewee: German business development executive in an US American IT company I)

performance of its customers. As GE® demonstrates, *Software-as-a-Service* solutions can be brought to market by a big multinational company independently. In contrast and under consideration of available resources, Portuguese SMEs might obtain greater benefits through cooperation, such as the ESI platform could offer.

Hereafter, it follows a summary of benefits for the potential platform members, which would be affected by adding *Big Data* services to the range of services of the ESI platform. It is necessary to be aware of these arguments, since "selling the platform concept" has to involve the demand and needs of all potential interest groups. Furthermore, the overview considers the suggestion of Iansiti and Lakhani (2014, p. 93) to adapt the process of "value creation" of business models to survive the digital "transformation".

Benefits for the Interest Groups

Following similar arguments as were used in section "Proposal of a Business Idea - Embedded Systems Implementation Platform", developers of *Big Data* solutions could benefit from pooling their resources to overcome the lack in scale.[25] Even though on the first sight the arguments in favor of this solution might not be as crucial as for ESI companies, since pure software solutions could theoretically be distributed solely online, the membership in such a platform provides several important advantages. Besides the fact that the direct access to the data generated by embedded systems is a very convincing argument to participate in the platform, there are several other reasons to participate.[26] Many of the competencies gained by being a platform member, are identified as the key success factors which are required to sell products and services to German industrial firms (see Appendices: Figure 15). As a single Portuguese company and especially as a start-up, these market requirements are almost impossible to meet. In addition to that, *Big Data* developers benefit for example from the distribution system established by the platform, but add also value to the platform by offering their solutions. This observation will be explained in the following from the perspective of ESI companies.

[25] According to Mr. João Brazão, there are several small *Big Data* software developers among the Anetie members

[26] For instance: Improved security of the software solutions, The platform demonstrates better economic stability than single firms, The transparency can be enhanced, etc.

As stated above, the possibility to provide "single-source solutions" will gain significance in the near future. The platform´s ESI companies can therefore enhance their competitiveness by cooperating with *Big Data* firms and still focus on their core business. Linking the ESI services with specific *Big Data* solutions can furthermore help to customize the platform´s value proposition to a specific niche within the target market of M&E firms and thus can help to further differentiate themselves from competitors. Since *Software-as-a-Service* solutions can either be "rented" for one-time tasks whenever needed or used permanently (Interviewee: German business development executive in an US American IT company I), the duration of the customer relationship will be extended.

These above mentioned benefits have direct impact on the services offerings of the platform´s customers, the M&E companies. This is due to the fact that M&E firms are not the end users of the platform´s solutions, but integrate them into their products. M&E firms can therefore be enabled to implement embedded systems into their products and offer outsourced *Big Data* services to their customers. Consequently, the beneficiary of the *Big Data* solutions will be the manufacturing enterprises[27], as the end users of the products.

The success of GE® shows its positive impact already: The advantages of software based optimization and efficiency gains will be a decisive factor in the decision-making process for or against a M&E company.[28] Furthermore, intensive cooperation with other companies will be a crucial factor to "survive" the *4th industrial revolution* towards *I-4.0*. Just the commitment towards cross-sector cooperation will ensure the competitiveness in the era of the *IoT* (Experton Group 2014, p. 25 and Interviewee: Project manager I 4.0 at a major business association in Germany). By providing "single-source solutions" to M&E companies, as GE® does, the platform can improve significantly the attractiveness of its offers. This results in a "mutually profitable long-term partnership" (Iansiti and Lakhani 2014, p. 93) between all stakeholders of the platform and eventually leads to more exports for Portugal.

[27] See "2. Further Development of a Specific Topic - Market Opportunities" for additional benefits for manufacturing enterprises

[28] According to a PWC (2014) study, 90% of the German industrial companies are of the opinion that the ability to analyze data will be a decisive competitiveness factor within the next five years

How to Capture Value

According to Iansiti and Lakhani (2014), the digitalization of service-offers requires new ways to "capture value", which means the manner of charging the customer for services. They represent the example of GE®, which can be adapted to the present proposal. Since GE´s® *Big Data* services create value by optimizing production systems, the economic benefits can be directly measured. That means, that the manufacturing enterprises just pay a share of the efficiency gains "back" to the M&E companies.[29] This is not just a clear and transparent way of charging for services, the argument of cost reductions could be furthermore a compelling argument in favor of the ESI platform to attract new customers.

In Appendices: Figure 25, it can be found a graphical representation of a proposal how an exemplary "Competence Centre - Big Data" could be integrated into the platform. It follows an illustration (see Appendices: Figure 26) which shows expansion possibilities of the platform. For instance, the brief description of an additional business opportunity in Appendix: Figure 24 is an example of a valuable complement for the platform, since *Cloud* data center will be essential in the near future[30] to store the data generated by CPS in manufacturing (Interviewee: German manager executive briefing center in an US American IT company II)

[29] The revenues could be shared between the involved platform members

[30] *Cloud* data center are already "necessary" for many ranges of application

3. Reflection on Learning

a. Previous Knowledge - Masters Content Applied

The project planning and implementation process required the practical application of a broad scope of knowledge and skills obtained during the master's program. Due to the given subject and objectives, the study was carried out as a one semester project. The course "Project Management"[31] served therefore as a helpful tool to plan the tasks, to estimate timeframes and to create and follow a reasonable structure. In order to deliver the project to the clients on time, a critical path[32] was identified and the work was structured in four subsequent phases (see Appendices: Figure 27). Moreover, typical project management tools like *Gantt* charts were used to coordinate the chronological sequence of activities with our clients in our regular meetings.

With regard to the topic-specific relevance of the study, the courses taught within the strategy major accounted for the largest share of applied master contents. These were: Strategy II, to identify the economic macro- and micro trends, assess the subsectors and apply basic strategy frameworks; Corporate Strategy, which enabled a deep understanding of strategic frameworks and theory and was decisive to identify market opportunities and the basis for a sustainable competitive advantage; International Business, which gave useful insights in internationalization strategies and market entry modes.

The strategy related knowledge was supplemented by Organizational Theory and Design[33], which helped to develop an adequate organizational structure for the platform to export ESI. The knowledge obtained during the marketing courses Marketing Planning and Sales Forces Management & Retailing laid the foundation to create step 2 of the ESI platform: Reaching the customer in Germany.

Last but not least, the practical work approach at Nova SBE including numerous group works, presentations and case studies helped to develop the (soft)skills needed to successfully

[31] Supplemented by the course book "Project Management: A Systems Approach to Planning, Scheduling, and Controlling"
[32] In particular determined by expert interviews
[33] Supplemented by the course book "Managing and Organizations: An Introduction to Theory and Practice"

deliver such a project. For instance, the masters prepared us for the regular meetings and presentations with our clients, taught us to consult external sources and to work in teams. This will be discussed in greater detail in the following subsection.

b. New Knowledge

Despite several demanding, business related tasks of this project, one of the most challenging hurdles to overcome was to understand the technical aspects of I-4.0. Since I-4.0 is driven by the realization of CPS and centralized IT infrastructure, it was necessary to achieve a good basic understanding of the technical principles behind these topics. For instance, a good interview preparation, which necessitates a good insight into the technical aspects, enables to ask precise and to get to the bottom of the questions during interviews. This results in value generating questions and answers, which finally give further insight into the subject. These insights are crucial to identify business opportunities, create strategies and make ultimately use of the obtained information. This means, developing non-business skills was necessary to create the basis to progress and effectively finish the project.

The fact that I-4.0 is currently emerging, creates new market opportunities on one hand. On the other hand, the availability of public available information for research purposes is relatively limited. These circumstances highlight again the importance of qualitative research, which means the ability to conduct successfully expert interviews. Since the time to conduct interviews was relatively limited[34], it was necessary to find a standardized but at the same time customized way to request and conduct interviews with suitable interview partners. The solution was to create a uniform approach, which could be, once created, applied to all potential interviewees. As a result, a framework for an email inquiry, as well as a framework for an interview guideline and a general privacy agreement was created. While each email inquiry and interview guideline was customized with individual information to attract interest of the interviewee[35] and to achieve the best possible results in terms of depth of information, the privacy agreement was uniform. In order to meet the

[34] Part of the critical path

[35] The interviewees were experts who published in Industry 4.0 specific publications. Each email inquiry was addressing the specific field of interest of the respective expert

expected quality of professional expert interviews, Yin´s (2011) textbook "Qualitative Research from Start to Finish" served as the source to create the documents. In addition to that, we took into consideration guidelines published by German research institutions to develop interview questions and the privacy agreement to ensure compliance with the standards used in Germany.

As the project progressed, several legal, customer and market specific issues had to be considered for the purpose of meeting the requirements of the German market. For this reason, interdisciplinary sources had to be consulted. For instance, the recommendations regarding the development of a proof of concept (see Appendices: Figure 28) required basic knowledge of necessary certificates for imports, safety markings and quality seals.

The importance and game changing potential of the *IoT* has even impact on one of the key theories I learned during my major – Porter´s *Five Forces that Shape Competition*. As Porter (2014) himself published in the Harvard Business Review, *I-4.0* reshapes the industry structures and boundaries and makes therefore essential for each company to rethink the way of creating and capturing value. In order to show firms ways to secure their competitive advantage, Porter developed a framework of "New Strategic Choices". Hence, working on the present thesis brought my knowledge up to date to the changing circumstances currently evolving in the market. Furthermore, the new framework was already taken into consideration to develop the recommendations.

To conclude, I would like to highlight the importance of presenting and visualizing the project results in an appealing and professional way. For this purpose, our supervisor and Professor Alexandre Dias da Cunha provided us with the material of Professor Luís Filipe Lopes' course "Consulting". The PowerPoint presentation for our clients was created according to the rules and guidelines recommended. We chose the "Teleprompter" format, which is suitable to present the work to an audience and still allows independently of additional explanation to understand the content of the work.

c. Personal Experience: My Weaknesses and Key Strengths

As mentioned above, it was a challenging experience to become acquainted with the technical point of view of the work. I was clearly not prepared and lacked technical basic knowledge. Even thought I could manage that issue well over the course of the project, it opened my eyes regarding interdisciplinary knowledge. Not just working on the project itself, also the awareness of the emerging importance of *I-4.0* helped me to become convinced about the increasing significance of technic related topics in our everyday lives. In the future, I will keep myself informed about such topics and will acquire a broader base of natural sciences.

Moreover, working on the project showed me the relevance to share ideas and thoughts with experienced people. At the beginning of the project, I was hesitating to discuss doubts with our supervisor and the clients. After some time working on the project, I became more familiar with being in regular meetings with executive personnel and started to benefit of their presence and helpful advices. In future projects, I will consult experienced colleagues to clarify doubts in case my own efforts appear to be insufficient.

In my point of view, one of my strengths is the ability to adapt to new situations and to be flexible. Even thought it was new to me, I developed for example a well working approach to find, attract and finally question interviewees. The gathered data not just allowed us a deep insight into the topic, but furthermore constituted the basis to develop recommendations. I was able to assess the interviewees' opinions, combine the outcomes and enrich the information with research data. Lastly, I was able to apply theoretical knowledge from the masters and additional information in order to add value to the project outcome.

d. Benefit of Hindsight

What Added Most Value?

We had to balance between two opposing interests – gathering information as fast as possible and maximize the insight into the topic. In retrospect, I am convinced that the chosen approach of conducting explorative expert interviews was crucial for the success of our project. The "faster" alternative of doing research and carry out a survey with standardized and broad questions, would probably have generated common sense answers instead of value adding information. Since the available information about *I-4.0* is very limited, I even think

we could find insights the broad public is not aware of yet. I even conclude from this that our recommendations show upcoming developments in the IT market and can really help the members of Anetie to position themselves to successful export to Germany. This implies that taking up to the *IoT in Manufacturing* was the right choice, since it enabled us to find business opportunities in the IT market, which is apart from *I-4.0* induced innovations, mostly mature and has high entry barriers due to high competition.

What should have been done Differently?

Even if our four phase approach (see Appendices: Figure 27) delivered very good results at the end, the rigid compliance to the different phases involved temporarily to the risk to jeopardize our claim to find the best possible solution for our clients.[36] This means that we should have showed more flexibility and conducted interviews with Portuguese decision-makers of SMEs in the IT area at an earlier stage. For instance, instead of finishing the second phase completely and subsequently start with the third phase, we should have started the third phase earlier. Already after the first interviews on the German side[37], we had in my opinion sufficient insights to anticipate promising subsectors based on incomplete information obtained in phase one and two. Considering the threat of a possible weak competitiveness of Portuguese firms relatively to their German counterparts by focusing on the manufacturing area of the *IoT*, we could have ended up with poor results. The delay would have stolen important time, which was necessary to reconsider the subsectors and consequentially could have forced us to develop recommendations for target markets, where Portuguese companies would not have the necessary resources to be competitive in Germany.

In addition to that, an earlier start of phase three could have helped us to find better quantitative data about the identified subsectors. Such information could be very useful for Anetie members to recognize the domestic potential of their industries and coordinate themselves within Portugal by either using the concept of the ESI platform we developed by adding new elements (see Appendices: Figure 26) or by applying the platform idea to new sectors.

[36] Even though at the start of phase three, we ensured that Portuguese companies have basic know-how and capabilities to export in at least one of the identified subsectors

[37] German side = market demand side

Bibliography[38]

Acatech. 2013. *Recommendations for implementing the strategic initiative INDUSTRIE 4.0.* Acatech and Forschungsunion, Tech. Rep. April 2013.

Bauer, W., Schlund S. and Marrenbach D. 2014. *Industrie 4.0: Volkswirtschaftliches Potenzial für Deutschland*. BITKOM and Fraunhofer IAO. Berlin

Bitkom. 2014. *Press release: Weltmarkt für Big Data wächst rasant*. 04.04.2014, http://www.bitkom.org/de/markt_statistik/79758_79087.aspx

BMWi. 2014. *Smart Service Welt – Internetbasierte Dienste für die Wirtschaft*. September 2014

CCILA. 2014. *Master-thesis Export Promotion: Objectives and deliverables*. Provided during the first kick-off meeting by CCILA´s managing director Hans-Joachim Böhmer.

Chui, Michael and Löffler, Markus and Roger Roberts. 2010. *The Internet of Things*, March 2010, http://www.mckinsey.com/insights/high_tech_telecoms_internet/the_internet_of_things

Clegg, Stewart R. and Kornberger, Martin and Pitsis, Tyrone. 2011. *Managing and Organizations: An Introduction to Theory and Practice*, London: SAGE.

EMC Corporation. 2014. *Deutschland Länderinfo 2014*. http://www.emc.com/collateral/analyst-reports/idc-digital-universe-2014-germany.pdf

Grant, Robert M. 2010. *Contemporary Strategy Analysis*. New York: Wiley

Kerzner, Harold. 2009. *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New York: John Wiley & Sons.

Iansiti, Marco and Lakhani, Karim R. 2014. *Digital Ubiquity: How Connections, Sensors, and Data Are Revolutionizing Business.* Harvard Business Review. November 2014. 90-99.

Porter, Michael E. and Heppelmann, James E. 2014. *How Smart, Connected Products Are Transforming Competition.* Harvard Business Review. November 2014. 64-88.

PWC. 2014. Industrie 4.0: *Chancen und Herausforderungen der vierten industriellen Revolution*. http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/industrie-4-0

Roland Berger Strategy Consultants. 2013. *PORTUGALPLUS - Investimento e Exportação.* PowerPoint slides. Provided by the supervisor

Tönnesmann, Jens. 2014. *Internet der Dinge - Vernetzte Industrie bietet Gründern Chancen*. Wirtschaftswoche. November 2014. http://www.wiwo.de/technologie/smarthome/internet-der-dinge-vernetzte-industrie-bietet-gruendern-chancen/9378340.html

Yin, Robert K. 2011. *Qualitative Research from Start to Finish*. New York: Guilford Press.

[38] The work project for our clients contains additional sources, which are cited in the project´s PowerPoint presentation